EASTERN KENTUCKY UNIVERSITY

Department of Physics and Astronomy

Study of Proton and Neutron Activation of Metal Samples in Low Earth Orbit

July 19,1984

Quarterly Technical Report

Contract # NAS8-35180

(Principal Investigator: C. E. Laird)

Prepared for

George C. Marshall Space Flight Center

Marshall Space Flight Center, Alabama 35812

EASTERN KENTUCKY UNIVERSITY

Richmond, Kentucky 40475

QUARTERLY REPORT

During the last quarter of activity under NASA Contract NAS8-35180, as extended, the following activities have been undertaken:

1. the analysis of the gamma-ray spectra taken from samples flown in Spacelab II has been completed.

2. the search for and review of neutron and proton activation cross-sections needed to analyze the results of the LDEF activation measurements has been continued. Calculations of neutron induced activation for the LDEF samples have been done with currently available cross sections.

3. the data analysis plan for the LDEF and Spacelab II samples has been given initial consideration.

4. the plan to measure relevant cross-sections with nuclear accelerator measurements have been continued while awaiting the scheduling of beam time.

5. the preparation of an extended gamma-ray calibration sources continues through planning and direct measurement of gamma ray efficiency for a Ge(Li) as a function of position along the surface of the detector housing.

Copies of the result tables of the analysis of the Spacelab II samples are being sent to Dr. G. Fishman at MSFC. Originally, it was planned that the program HYPERMET Would be used to analyze the gamma-ray spectra. However, since the conversion of HYPERMET to the VAX 11/780 has not yet been completed, a method was found by which the program SAMPO on the University of Kentucky IBM 3038 could be used. No further analysis of the gamma-ray spectra is needed.

The search for neutron and proton activation cross section has been continued. Three significant aspects of this search are the acquisition (1) of a report by F. J. Haasbroek, et al., the National Physical Research Laboratory, Pretoua, South Africa, (2) of an Indiana University dissertation by Michael Sadler, and (3) of copies of ACTL82 and ECPL82 from Reactor Safety Information Center, Oak Ridge. The report by Haasbroek, et al. contains excitation functions for Co, Ni, and Ta up to 85MeV or above. These have been converted to cross-sections and added to the list presently available. Further information from the South African group will be sought.

The disseration by Dr. M. E. Sadler contains considerable information about activation cross sections on Ni isotopes from 80 to 160 MeV. This information has been evaluated, interpolated and extrapolated to obtain approximate cross sections for natural nickel in this energy range.

ACTL82 and ECPL82 are tabulated reaction cross section for energies up to and above 20 MeV incident energy. ACTL82 is a compilation of neutron activation cross sections and ECPL82 is a

collection of charged particle reaction cross sections. These are presently being studied for further inclusion in the current tabulation.

The data analysis plan for the future samples has been given initial consideration, partially in view of the results of the analysis of the samples already counted. One problem that should be given further study before the LDEF samples are returned involves background. There are many (approximately 60) peaks seen in the background spectra for energies up to 2 MeV. One of these lines (at 846 KeV) coincides with one which is potentially observable from activation of the Ni and Co samples. The intensities of the background peaks varies from sample to sample, partially due to the shielding of the background source by the sample, due to radiation originally present in the samples, and due to possible fluctuations in the background sources. In order to account for these "background" problems a series of background spectra should be taken with a set of original samples placed in the same geometry as the LDEF samples. Long counting times should be used for each sample with spectra being recorded once a day for a period of five to seven days. After initially being checked for gain shifts and other problems, these spectra can be summed and analyzed to allow for a good determination of the background for each sample. To more clearly identify background peaks, a background spectrum similar to the ones above should be taken both inside and outside the low background facility. These in conjunction with those already taken for the Spacelab II samples

will help resolve some questions about the existence and intensity of certain weak peaks in the background.

Presuming that SAMPO or another similar gamma-ray analysis program will be used to analyze the LDEF sample spectra, periodic accumulation of gamma spectra with a weak gamma source would greatly facilitate the analysis process. This could be done with a weak EU-152 source having an activity of about 1-10 nC. A source stronger than this might cause summing in the spectra while one smaller than this would require too long a counting period to be practical. Note that a 2π geometry (50% maximum efficiency) would mean that about one Eu-152 gamma/sec would enter the Ge(Li) detector per decay or 37 counts/sec per nanocurie. Ten nanocuries would mean 370 counts/sec so little summing should occur. A weak source will be prepared with the extended calibration source now being made.

The measurement of relevant cross-sections with a nuclear zccelerator is awaiting the assignment of beam time at Indiana University Cyclotron Facility. Dr. Tom Ward of IUCF has agreed to collaborate on this effort and is presently seeking beam-time in a parasitic mode. Hopefully, activation of samples will begin during August. In anticipation of this work was concluded earlier in the summer on interfacing a Canberra ADC to an Apple IIe Computer which will be used both at Eastern and at IUCF. The Apple acts as a controller and data accumulation device with rapid data storage on a 5 1/4 inch floppy disk. Software to display the data using Apple graphics has been developed as well as that which can be used to do some data analysis with the

Apple. Procedures for transferring the data to the VAX for detailed analysis are currently being developed.

The development of an extended gamma-ray calibration sources continues. The plan calls for drop evaporating Eu-152 onto sixty-four (64) one-quarter inch squares on a thin plastic material. Each drop will be counted in a shielded geometry to ascertain the uniformity of activity. If needed, small corrections to the activity will be made. A uniformity within about 10% should be readily obtainable. As previously mentioned, one nanocurie of activity is 37 gammas per second entering the detector. If it is planned to keep the count rate at 1000 cps or less to prevent summing and other effects, this source should have less than 40 nc total activity. Thus each drop will have about .6 nc activity.

During the next quarter activities will continue on items 2-4 previously listed. Further considerations of the results of item 1 will most surely be done although that analysis is complete. The most pressing problem is scheduling of beam-time at IUCF. This delay will most probably require that a no cost extension of the contract be requested in the near future.